Sample Regents A

1. A potential drop of 50. volts is measured across a 250-ohm resistor. What is the power developed in the resistor?

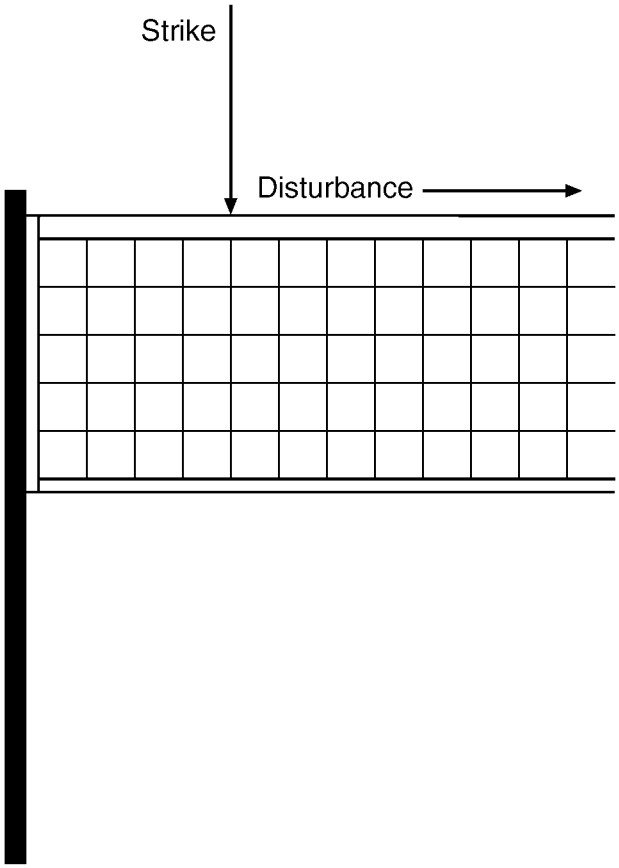
   1) 0.20 W

   2) 5.0 W

   3) 10. W

   4) 50. W

2. A student strikes the top rope of a volleyball net, sending a single vibratory disturbance along the length of the net, as shown in the diagram below.



   This disturbance is best described as

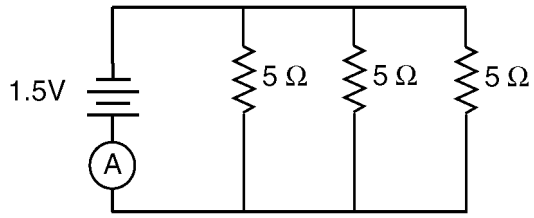
   1) a pulse

   2) a longitudinal wave

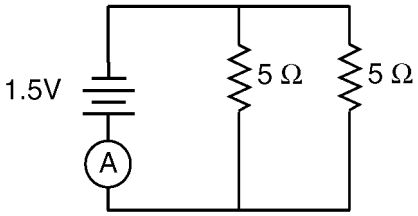
   3) a periodic wave

   4) an electromagnetic wave

3. In which circuit would ammeter A show the greatest current?



1)



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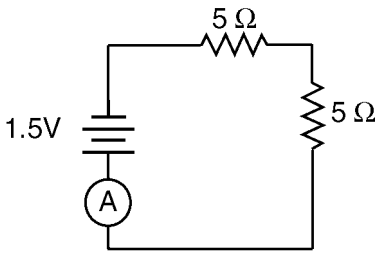

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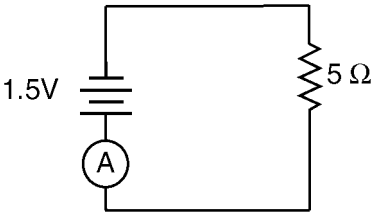

4)

4. In order to produce a magnetic field, an electric charge must be

   1) negative

   2) stationary

   3) positive

   4) moving

5. What is the speed of a 1.0×10^3-kilogram car that has a momentum of 2.0×10^4 kilogram • meters per second east?

   1) 5.0×10^{-2} m/s

   2) 2.0×10^1 m/s

   3) 1.0×10^4 m/s

   4) 2.0×10^7 m/s

6. If the frequency of a periodic wave is doubled, the period of the wave will be

   1) halved

   2) doubled

   3) quartered

   4) quadrupled

Base your answers to questions **7** and **8** on the information and table below.

The weight of an object was determined at five different distances from the center of Earth. The results are shown in the table below. Position *A* represents results for the object at the surface of Earth.

Position	Distance from Earth's Center (m)	Weight (N)
A	6.37×10^6	1.0×10^3
B	1.27×10^7	2.5×10^2
C	1.91×10^7	1.1×10^2
D	2.55×10^7	6.3×10^1
E	3.19×10^7	4.0×10^1

7. The approximate mass of the object is

   1) 0.01 kg

   2) 10 kg

   3) 100 kg

   4) 1,000 kg

8. At what distance from the center of Earth is the weight of the object approximately 28 newtons?

   1) 4.5×10^7 m

   2) 4.1×10^7 m

   3) 3.5×10^7 m

   4) 3.8×10^7 m

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9. A high school physics student is sitting in a seat reading this question. The magnitude of the force with which the seat is pushing up on the student to support him is closest to

   1) 0 N

   2) 60 N

   3) 600 N

   4) 6,000 N

10. The charge-to-mass ratio of an electron is

    1) 1.76×10^{-11} C/kg

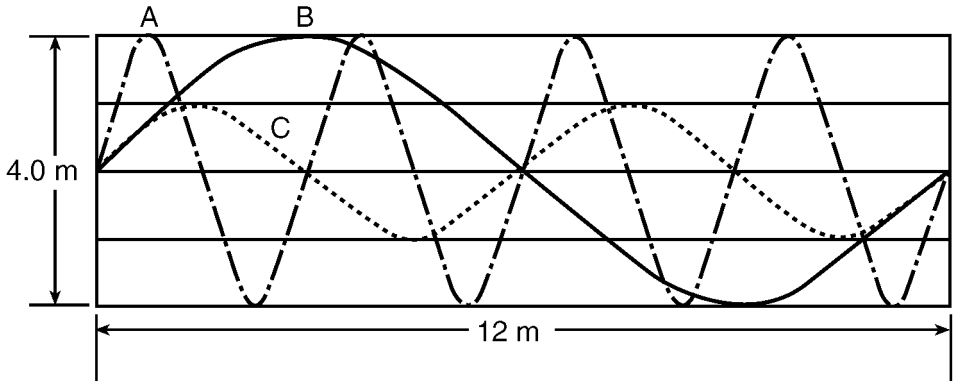
    2) 5.69×10^{-12} C/kg

    3) 1.76×10^{11} C/kg

    4) 5.69×10^{12} C/kg

Base your answers to questions **11** through **13** on the information and diagram below.

Three waves, *A*, *B*, and *C*,travel 12 meters in 2.0 seconds through the same medium as shown in the diagram below.



11. What is the speed of wave *B*?

12. What is the period of wave *A*?

13. What is the amplitude of wave *C*?

14. What happens to the frequency and the speed of an electromagnetic wave as it passes from air into glass?

    1) The frequency increases and the speed decreases.

    2) The frequency decreases and the speed increases.

    3) The frequency remains the same and the speed decreases.

    4) The frequency remains the same and the speed increases.

15. The energy equivalent of 5.0×10^{-3} kilogram is

    1) 8.0×10^{5} J

    2) 1.5×10^{6} J

    3) 4.5×10^{14} J

    4) 3.0×10^{19} J

16. State the *two* general characteristics that are used to define a vector quantity.

Base your answers to questions **17** through **21** on the information below.

A manufacturer's advertisement claims that their 1,250-kilogram (12,300-newton) sports car can accelerate on a level road from 0 to 60.0 miles per hour (0 to 26.8 meters per second) in 3.75 seconds.

17. Determine the acceleration, in meters per second^2, of the car according to the advertisement.

_____

18. Calculate the net force required to give the car the acceleration claimed in the advertisement. [Show all work, including the equation and substitution with units.]

_____

19. Using the values for the forces you have calculated, explain whether or not the manufacturer's claim for the car's acceleration is possible.

_____

20. What is the normal force exerted by the road on the car?

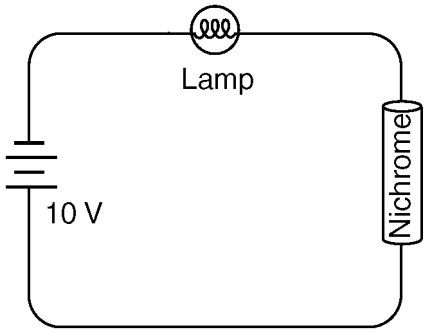
_____

21. The coefficient of friction between the car's tires and the road is 0.80. Calculate the maximum force of friction between the car's tires and the road. [Show all work, including the equation andsubstitution with units.]

_____

_____

22. The diagram below represents a lamp, a 10-volt battery, and a length of nichrome wire connected in series.



As the temperature of the nichrome is decreased, the brightness of the lamp will

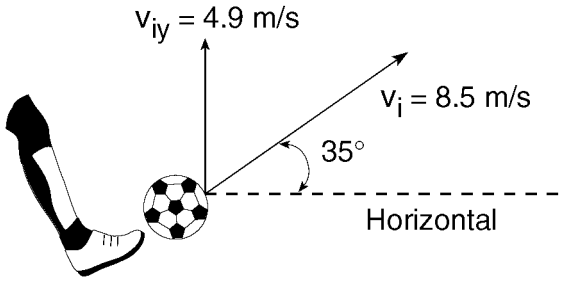
1) decrease

2) increase

3) remain the same

Base your answers to questions **23** and **24** on the information and diagram below.

A child kicks a ball with an initial velocity of 8.5 meters per second at an angle of 35º with the horizontal, as shown. The ball has an initial vertical velocity of 4.9 meters per second and a total time of flight of 1.0 second. [Neglect air resistance.]



23. The horizontal component of the ball's initial velocity is approximately

    1) 3.6 m/s

    2) 7.0 m/s

    3) 4.9 m/s

    4) 13 m/s

24. The maximum height reached by the ball is approximately

    1) 1.2 m

    2) 2.5 m

    3) 4.9 m

    4) 8.5 m

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25. A boat weighing 9.0×10^2 Newtons requires a horizontal force of 6.0×10^2 Newtons to move it across the water at 1.5×10^1 meters per second. The boat's engine must provide energy at the rate of

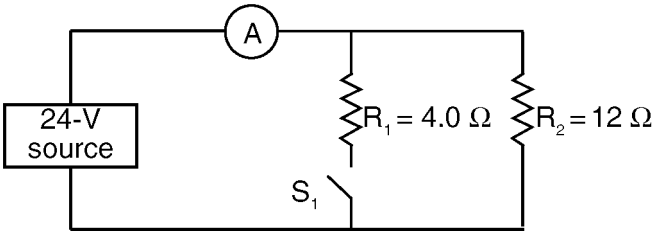
    1) 2.5×10^{-2} J

    2) 4.0×10^1 W

    3) 7.5×10^3 J

    4) 9.0×10^3 W

Base your answers to questions **26** and **27** on the circuit diagram below.



26. If switch S_1 is closed, the equivalent resistance of the circuit is

    1) 8.0 Ω

    2) 2.0 Ω

    3) 3.0 Ω

    4) 16 Ω

27. If switch S_1 is open, the reading of ammeter *A* is

    1) 0.50 A

    2) 2.0 A

    3) 1.5 A

    4) 6.0 A

Base your answers to questions **28** and **29** on the information below.

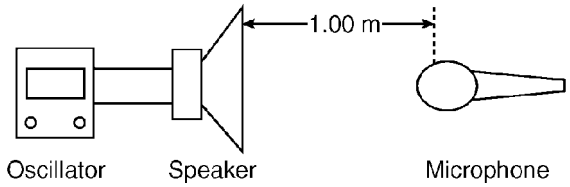
A lightweight sphere hangs by an insulating thread. A student wishes to determine if the sphere is neutral or electrostatically charged. She has a negatively charged hard rubber rod and a positively charged glass rod. She does not touch the sphere with the rods, but runs tests by bringing them near the sphere one at a time.

28. Describe the test result that would prove that the sphere is positively charged.

29. Describe the test result that would prove that the sphere is neutral.

Base your answers to questions **30** through **32** on the information and diagram below.

A system consists of an oscillator and a speaker that emits a 1,000.-hertz sound wave. A microphone detects the sound wave 1.00 meter from the speaker.



30. Which type of wave is emitted by the speaker?

    1) transverse

    2) electromagnetic

    3) circular

    4) longitudinal

31. The microphone is moved to a new fixed location 0.50 meter in front of the speaker. Compared to the sound waves detected at the 1.00-meter position, the sound waves detected at the 0.50-meter position have a different

    1) wave speed

    2) frequency

    3) amplitude

    4) wavelength

32. The microphone is moved at constant speed from the 0.50-meter position back to its original position 1.00 meter from the speaker. Compared to the 1,000.-hertz frequency emitted by the speaker, the frequency detected by the moving microphone is

    1) lower

    2) higher

    3) the same

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33. An airplane is moving with a constant velocity in level flight. Compare the magnitude of the forward force provided by the engines to the magnitude of the backward frictional drag force.

_____

Base your answers to questions **34** and **35** on the information below.

A soccer player accelerates a 0.50-kilogram soccer ball by kicking it with a net force of 5.0 newtons.

34. Calculate the magnitude of the acceleration of the ball. [Show all work, including the equation and substitution with units.]

35. What is the magnitude of the force of the soccer ball on the player's foot?

36. A box is pushed toward the right across a classroom floor. The force of friction on the box is directed toward the

    1) right

    2) floor

    3) ceiling

    4) left

Base your answers to questions **37** and **38** on the information below.

A proton starts from rest and gains 8.35×10^{-14} joule of kinetic energy as it accelerates between points *A* and *B* in an electric field.

37. Calculate the potential difference between points *A* and *B* in the electric field. [Show all work, including the equation and substitution with units.]

38. What is the final speed of the proton?

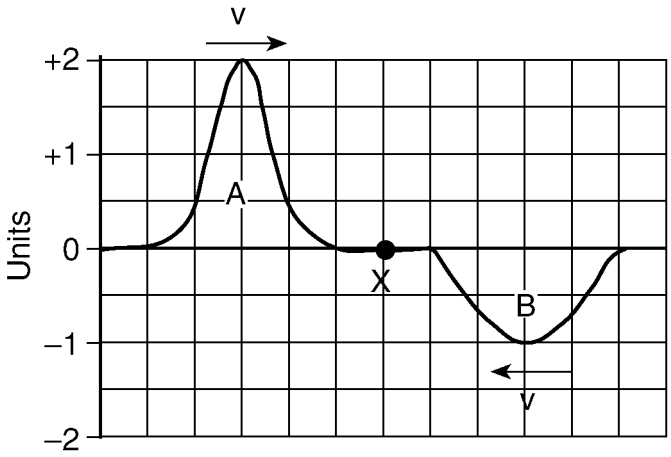
    1) 5.00×10^{13} m/s

    2) 1.00×10^{7} m/s

    3) 7.07×10^{6} m/s

    4) 4.28×10^{8} m/s

39. Two pulses, *A* and *B*, travel toward each other along the same rope, as shown below.



When the centers of the two pulses meet at point *X*, the amplitude at the center of the resultant pulse will be

1) +1 unit

2) +2 units

3) 0

4) –1 unit

40. How much time does it take light from a flash camera to reach a subject 6.0 meters across a room?

1) 5.0×10^{-8} s

2) 2.0×10^{-8} s

3) 5.0×10^{-9} s

4) 2.0×10^{-7} s

41. The superposition of two waves traveling in the same medium produces a standing wave pattern if the two waves have

1) the same frequency, the same amplitude, and travel in the same direction

2) the same frequency, different amplitudes, and travel in the same direction

3) the same frequency, the same amplitude, and travel in opposite directions

4) the same frequency, different amplitudes, and travel in opposite directions

Base your answers to questions **42** and **43** on the information and equation below.

During the process of beta ($ß^-$) emission, a neutron in the nucleus of an atom is converted into a proton, an electron, an electron antineutrino, and energy.

neutron $\rightarrow$ proton + electron + electron antineutrino + energy

42. Since charge must be conserved in the reaction shown, what charge must an electron antineutrino carry?

43. Based on conservation laws, how does the mass of the neutron compare to the mass of the proton?

44. A 1-kilogram rock is dropped from a cliff 90 meters high. After falling 20 meters, the kinetic energy of the rock is approximately

    1) 20 J

    2) 200 J

    3) 700 J

    4) 900 J

45. Which object has the most inertia?

    1) a 0.001-kilogram bumblebee traveling at 2 meters per second

    2) a 0.1-kilogram baseball traveling at 20 meters per second

    3) a 5-kilogram bowling ball traveling at 3 meters per second

    4) a 10.-kilogram sled at rest

46. The force that holds protons and neutrons together is known as the

    1) gravitational force

    2) magnetic force

    3) electrostatic force

    4) strong force

47. A skater increases her speed uniformly from 2.0 meters per second to 7.0 meters per second over a distance of 12 meters. The magnitude of her acceleration as she travels this 12 meters is

    1) 1.9 m/s^2

    2) 2.2 m/s^2

    3) 2.4 m/s^2

    4) 3.8 m/s^2

48. Excited hydrogen atoms are all in the $n = 3$ state. How many different photon energies could possibly be emitted as these atoms return to the ground state?

    1) 1

    2) 2

    3) 3

    4) 4

49. A 40.-kilogram mass is moving across a horizontal surface at 5.0 meters per second. What is the magnitude of the net force required to bring the mass to a stop in 8.0 seconds?

    1) 1.0 N

    2) 5.0 N

    3) 25 N

    4) 40. N

50. A ball thrown vertically upward reaches a maximum height of 30. meters above the surface of Earth. At its maximum height, the speed of the ball is

    1) 0.0 m/s

    2) 9.8 m/s

    3) 3.1 m/s

    4) 24 m/s

Base your answers to questions **51** through **53** on the information below.

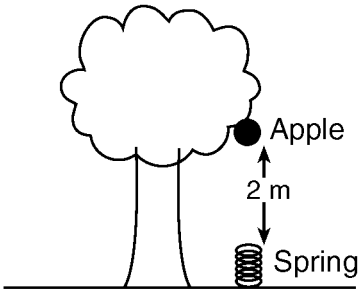
The light of the "alpha line" in the Balmer series of the hydrogen spectrum has a wavelength of 6.58×10^{-7} meter.

51. Using your answer to the previous question explain whether or not this result verifies that the "alpha line" corresponds to a transition from energy level $n = 3$ to energy level $n = 2$ in a hydrogen atom.

52. Calculate the energy of an "alpha line" photon in joules. [Show all work, including the equation and substitution with units.]

53. What is the energy of an "alpha line" photon in electronvolts?

54. The diagram below shows a 0.1-kilogram apple attached to a branch of a tree 2 meters above a spring on the ground below.



The apple falls and hits the spring, compressing it 0.1 meter from its rest position. If all of the gravitational potential energy of the apple on the tree is transferred to the spring when it is compressed, what is the spring constant of this spring?

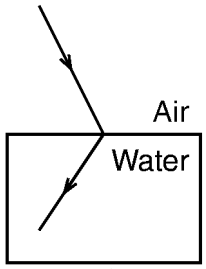
1) 10 N/m

2) 40 N/m

3) 100 N/m

4) 400 N/m

55. Which ray diagram best represents the phenomenon of refraction?



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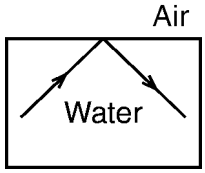

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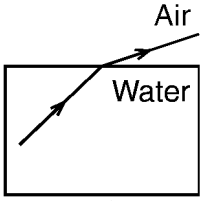

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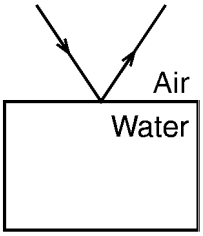


4)

56. A 10.-meter length of wire with a cross-sectional area of 3.0×10^{-6} square meter has a resistance of 9.4×10^{-2} ohm at 20° Celsius. The wire is most likely made of

1) aluminum

2) silver

3) tungsten

4) copper

57. A ball of mass M at the end of a string is swinging in a horizontal circular path of radius R at constant speed V. Which combination of changes would require the greatest increase in the centripetal force acting on the ball?

1) halving V and halving R

2) halving V and doubling R

3) doubling V and doubling R

4) doubling V and halving R

58. A photon of light carries

1) both energy and momentum

2) neither energy nor momentum

3) momentum, but not energy

4) energy, but not momentum

Base your answers to questions **59** and **60** on the passage below.

Shattering Glass

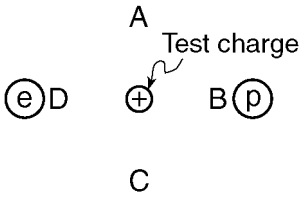
An old television commercial for audio recording tape showed a singer breaking a wine glass with her voice. The question was then asked if this was actually her voice or a recording. The inference is that the tape is of such high quality that the excellent reproduction of the sound is able to break glass.

This is a demonstration of resonance. It is certainly possibly to break a wine glass with an amplified singing voice. If the frequency of the voice is the same as the natural frequency of the glass, and the sound is loud enough, the glass can be set into a resonant vibration whose amplitude is large enough to surpass the elastic limit of the glass. But the inference that high-quality reproduction is necessary is not justified. All that is important is that the frequency is recorded and played back correctly. The waveform of the sound can be altered as long as the frequency remains the same. Suppose, for example, that the singer sings a perfect sine wave, but the tape records it as a square wave. If the tape player plays the sound back at the right speed, the glass will still receive energy at the resonance frequency and will be set into vibration leading to breakage, even though the tape reproduction was terrible. Thus, this phenomenon does not require high-quality reproduction and, thus, does not demonstrate the quality of the recording tape. What it does demonstrate is the quality of the tape player, in that it played back the tape at an accurate speed!

59. Explain why the glass would not break if the tape player did not play back at an accurate speed.

60. List *two* properties that a singer's voice must have in order to shatter a glass.

61. A positive test charge is placed between an electron, *e*, and a proton, *p*, as shown in the diagram below.



When the test charge is released, it will move toward

1) *D*

2) *A*

3) *C*

4) *B*

62. A girl leaves a history classroom and walks 10. meters north to a drinking fountain. Then she turns and walks 30. meters south to an art classroom. What is the girl's total displacement from the history classroom to the art classroom?

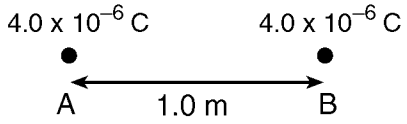
1) 20. m south

2) 20. m north

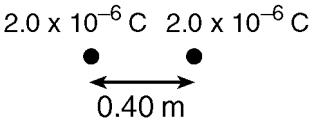
3) 40. m south

4) 40. m north

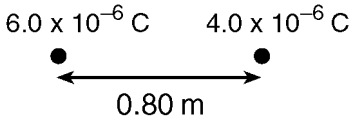
63. The diagram below shows two small metal spheres, *A* and *B*. Each sphere possesses a net charge of 4.0×10^{-6} coulomb. The spheres are separated by a distance of 1.0 meter.



Which combination of charged spheres and separation distance produces an electrostatic force of the same magnitude as the electrostatic force between spheres *A* and *B*?



1)



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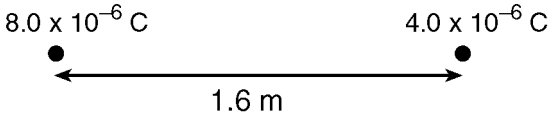
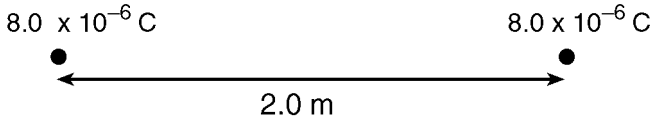


3)



4)

64. Which wave phenomenon makes it possible for a player to hear the sound from a referee's whistle in an open field even when standing behind the referee?

1) Doppler effect

2) reflection

3) diffraction

4) refraction

65. If the speed of a car is doubled, the kinetic energy of the car is

1) quadrupled

2) quartered

3) doubled

4) halved

66. In a simple electric circuit, a 110-volt electric heater draws 2.0 amperes of current. The resistance of the heater is

1) 55 Ω

2) 28 Ω

3) 220 Ω

4) 0.018 Ω

67. A student does 60. joules of work pushing a 3.0-kilogram box up the full length of a ramp that is 5.0 meters long. What is the magnitude of the force applied to the box to do this work?

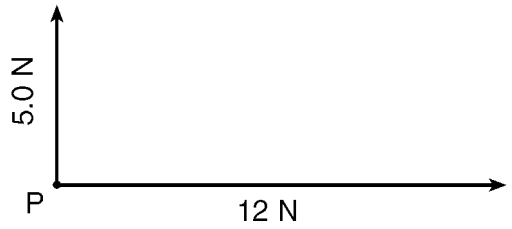
    1) 20. N

    2) 15 N

    3) 12 N

    4) 4.0 N

68. The diagram below represents a 5.0-newton force and a 12-newton force acting on point P.



    The resultant of the two forces has a magnitude of

    1) 5.0 N

    2) 7.0 N

    3) 12 N

    4) 13 N

69. One car travels 40. meters due east in 5.0 seconds, and a second car travels 64 meters due west in 8.0 seconds. During their periods of travel, the cars definitely had the same

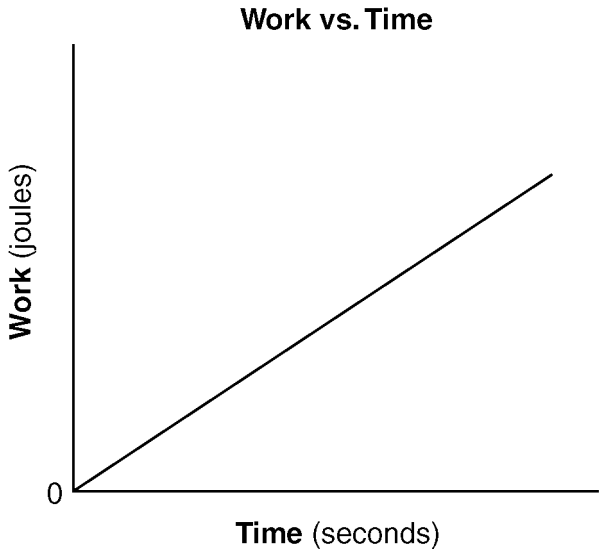
    1) total displacement

    2) average speed

    3) average velocity

    4) change in momentum

70. The graph below represents the relationship between the work done by a student running up a flight of stairs and the time of ascent.



What does the slope of this graph represent?

1) power

2) impulse

3) speed

4) momentum

71. An electron in a mercury atom drops from energy level *i* to the ground state by emitting a single photon. This photon has an energy of

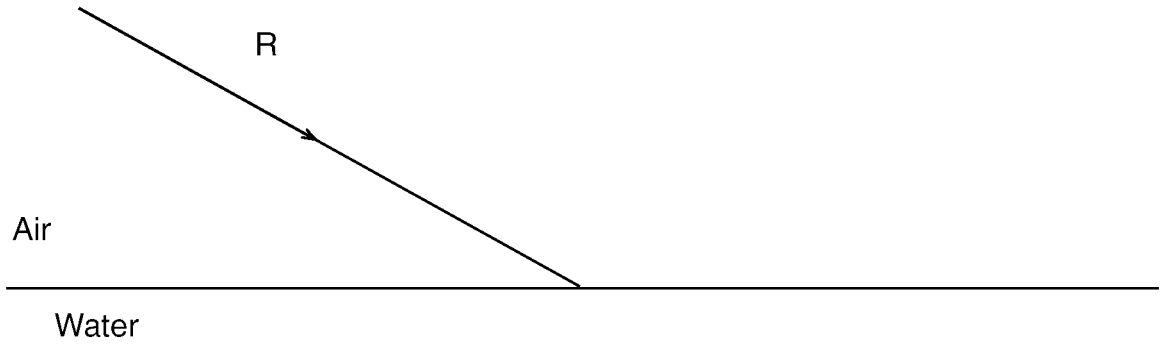
1) 1.56 eV

2) 8.82 eV

3) 10.38 eV

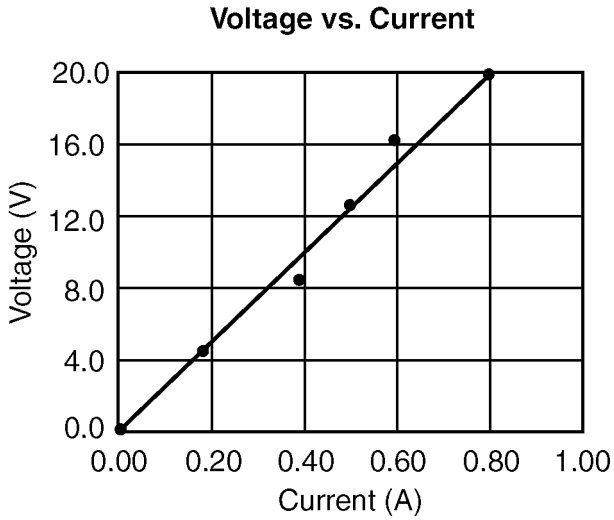
4) 11.94 eV

72. In the diagram, a light ray, *R*,strikes the boundary of air and water.



Using a protractor and straightedge, determine the angle of incidence *and* draw the reflected ray on the diagram.

73. A long copper wire was connected to a voltage source. The voltage was varied and the current through the wire measured, while temperature was held constant. The collected data are represented by the graph below.



Using the graph, determine the resistance of the copper wire.

74. Two physics students have been selected by NASA to accompany astronauts on a future mission to the Moon. The students are to design and carryout a simple experiment to measure the acceleration due to gravity on the surface of the Moon.

Describe an experiment that the students could conduct to measure the acceleration due to gravity on the Moon. Your description must include:

- the equipment needed
- what quantities would be measured using the equipment
- what procedure the students should follow inconducting their experiment
- what equations and/or calculations the students would need to do to arrive at a value for the acceleration due to gravity on the Moon

Sample Regents A
Answer Key

1. 3

2. 1

3. 1

4. 4

5. 2

6. 1

7. 3

8. 4

9. 3

10. 3

11. Allow credit for 6.0 m/s or 6 m/s.

12. Allow credit for 0.50 s or 0.5 s.

13. Allow credit for 1.0 m or 1 m.

14. 3

15. 3

16. Allow credit for **magnitude** or **size** and credit for **direction**.

17. Allow credit for **7.15** m/s^2

18. $F\,t = \Delta p$

$F = \frac{m\Delta v}{t}$

$F = \frac{(1250kg)(26.8m/s)}{3.75\ s}$

F = 8,930 N

19. Acceptable responses include, but are not limited to: — Yes. It is reasonable, because the available friction force is greater than the needed acceleration force. — Yes. The friction force is greater.— Yes. The accelerating force is less.

20. Allow credit for 12,300 N.

21. $F_f = \mu F_N$

$F_f = (.80)(12{,}300\ N)$

F_f = 9,800 N *or* 9.8×10^3 N

22. 2

23. 3

24. 1

25. 4

26. 3

27. 2

28. Allow credit for indicating that the sphere is repelled by the positive rod (only).

29. Allow credit for indicating that the sphere is attracted to both rods.

30. 4

31. 3

32. 1

33. Allow credit for stating that the magnitudes of the two forces are equal.

34. $a = \frac{F\ net}{m}$

$a = \frac{5.0\ N}{0.50\ kg}$

a = 10 m/s^2 or 10 N/kg

35. Allow credit for **5.0** N or **–5.0** N.

Note: If the student indicates that the ball is kicked vertically, an answer of 10.0 N is acceptable. If the student indicates that the ball is kicked at an angle, an answer between 5.0 N and 10.0 N is acceptable.

36. 4

37. $V = \frac{W}{q}$

$V = \frac{8.35 \times 10^{-14}\ J}{1.60 \times 10^{-19}\ C}$

$V = 5.22 \times 10^5$ J/C or 5.22×10^5 V

38. 2

39. 1

40. 2

41. 3

42. zero *or* neutral

43. The neutron is more massive.

44. 2

45. 4

46. 4

47. 1

48. 3

49. 3

50. 1

51. Allow credit for indicating that the n_3 to n_2 transition is also **1.89** eV.

52. $E = \frac{hc}{\lambda}$

$E = (6.63 \times 10^{-34}\ Js)(3.00 \times 10^8\ m/s)$

$6.58 \times 10^{-7}\ m$

$E = 3.02 \times 10^{-19}$ J

53. Allow credit for **1.89** eV.

54. 4

55. 2

56. 1

57. 4

58. 1

59. Allow credit for indicating that the frequency of the sound is changed by variations in the speed of the tape.

60. Allow credit for correct frequency and/or credit for sufficient energy (amplitude or loudness or duration).

61. 1

62. 1

63. 4

64. 3

65. 1

66. 1

67. 3

68. 4

69. 2

70. 1

71. 2

72. Allow credit for indicating that the angle of incidence is 61° (±2°). and/or for drawing the reflected ray with θ_r = 61° (±2°).

73. Allow credit for 25.0 (±1.7) Ω .

74. freefall — object, meterstick, stopwatch — time of fall, distance of fall— drop object from measured height, time its fall — $d = v_i t + \frac{1}{2}at^2$

pendulum — string, mass, stopwatch, meterstick — length of pendulum, period — measure length of pendulum, period of pendulum— $T = 2\pi\ (\frac{\ell}{g})^{\frac{1}{2}}$

spring scale — spring scale,

known mass — weight on Moon of known mass — hang the weight on the spring scale and weigh it — $F_{g(M)} = mg_M$

Sample Regents A

Name _____ Class _____ Date _____

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Name _____ Class _____ Date _____

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